Public Workshop

Technology Assessment on Climate Change Emissions from Light-Duty Vehicles

HFC-134a Direct Emissions from Vehicle Air Conditioning Systems

April 20, 2004

Sacramento, CA

California Environmental Protection Agency
Air Resources Board

Three Modes of Direct Lifetime Emissions

Mode	Timing	When
Leakage "regular"	gradual, continuous	in-use
Accidental release "irregular"	fast, discrete	in-use
End-of-life release	fast, once	post-use

Existing MAC Emission Data

- Ford: 48-hr diurnal SHED testing vehicles and AC off
- Schwarz: (EC) Loss of charge over first 6 mo. to 6 yr. of life
- Stemmler: (Swiss) Avg. leak rate in a tunnel
- Others

Valid works; but narrow scopes for California fleet.

California Alternative: Emissions by Mass Balance

- Over a vehicle's life:

  Emissions = *Net inputs*

  = initial charge + recharges
  - amount recovered at end

- Net inputs: ~3 discrete events per veh.
- Data are accessible for many vehicles

Data Sources

- **Number of recharges**: 12,000 vehicles in 9 fleets; surveys of 966 vehicle owners
- **System capacity and amount per recharge**: 288 evacuations & recharges
- **End-of-life recovery**: survey of dismantlers, discussions with USEPA & California reclaimers
- **Lifetime**: EMFAC (16 yrs.)

Overview of Results

- Over 16-yr lifetime, the average California LDV emits ~1.4 kg of HFC-134a
- Results are basis for HFC inventory
- Includes releases & servicing fugitives
- This does not count:
  - excess emissions from “do-it-yourself” repairs
  - including emissions from topping Freon systems with HFC-134a

Comparisons

	Loss, grams/yr
Measured leak rates* (Ford)	26
Long-term loss (EC)	53
Tunnel study (Swiss)	123
ARB analysis	~85

* vehicles & ACs not operating

Caveats

- Our data are specific to the vehicle fleet of 2003
- HFC-134a LDVs still maturing
- We can't identify model-year effects
- Same analysis in a later year might give a different result

Climate Change Equivalent Emissions

- ~85 gm/yr/HFC-134a vehicle
- Or ~9 CO_2-equiv. gm/mile
- Of this, ~6 CO_2-equiv. gm/mile are due to leakage

Note: 200,000 lifetime VMT, GWP=1300

Opportunities for reducing leakage

- Compressor shaft seal
- Hoses
- Connections

Working with SAE's Interior Climate Control Standards Committee

California Environmental Protection Agency
Air Resources Board

Final Remarks

- **Analysis quantifies nominal GHG direct emission contribution from existing MACs in California**
- **Results are consistent with available research literature**
- **Potential paths for reductions can be identified**

References::

1) Staff Report, "HFC-134a Emissions from Current Light- and Medium-Duty Vehicles," CARB, Research Division, March 2004.

2) Vincent, R., Cleary, K., Ayala, A., and Corey, R., "Emissions of HFC-134a from Light-Duty Vehicles in California," **2004**, *SAE Technical Paper* 2004-01-2256.